

# Animal Bites and Rabies

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2006

# Cases

- 35 yo man bitten by dog while jogging in Thailand
- 82 yo woman bitten by squirrel in Silver Spring, Md
- 33 yo ID fellow bitten on the nose by his cat
- 15 yo paper boy bitten by stray dog in San Antonio
- 40 yo woman who is “bumped” by a bat she’s chasing with a tennis racket in her house
- 22 yo soldier hit in the face with a bat while riding in a truck in Iraq

# Outline

- Overview
- Dogs
- Cats
- Monkeys
- Rats
- Rabies
- Quiz

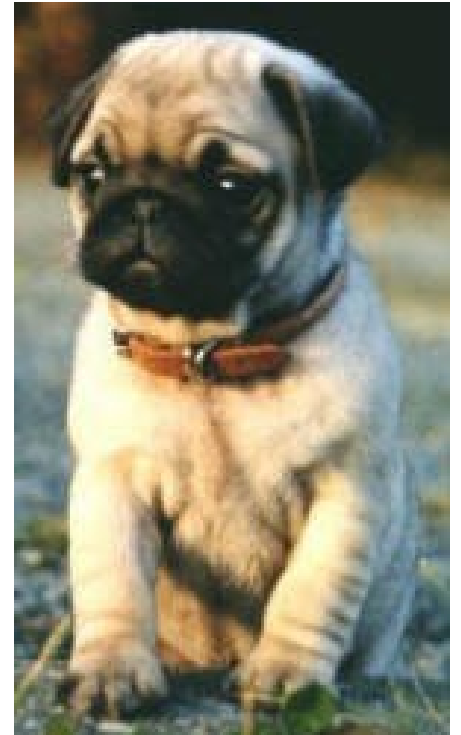


# Animal bites- overview

- Estimates on pets
  - 1 in 3 households has a dog
  - Over 100 million dogs and cats as pets in the U.S.
- Estimates on bites
  - Most people will be bitten in their lifetime
  - Almost 5 million Americans bitten each year
  - Most people do not seek medical attention for bites

# Dog bites

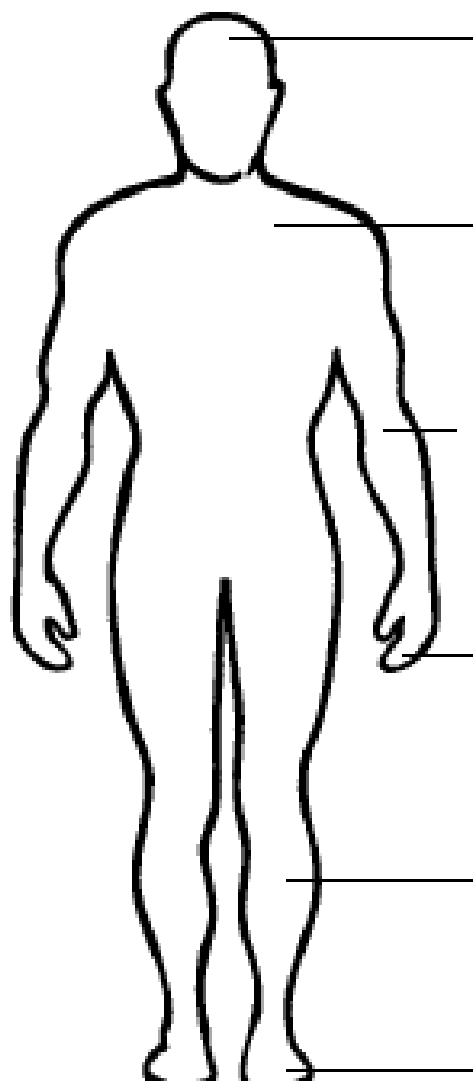
- Dogs are responsible for 80% of bites overall
  - Up to 20% become infected
- Most (70%) bites from animal known to the victim
  - Breaking up dog fights
  - Young men most common victims
  - More in summer months
- Deaths occur each year
  - Children and pit bulls
  - Exsanguinations



# Dog bites

- Dog jaws can exert 450 lb/in<sup>2</sup>
- Injuries
  - Lacerations
  - Evulsions
  - Punctures- most commonly infected
  - Crush injuries- most commonly infected
  - Scratches
- Most seek attention for
  - Facial bites
  - Dominant hand bites



| Location of Wound                                                                  |                           | Dog Bite      | Cat Bite |
|------------------------------------------------------------------------------------|---------------------------|---------------|----------|
|                                                                                    |                           | % of patients |          |
|  | Face, scalp, or neck      | 16            | 2        |
|                                                                                    | Trunk                     | 2             | 0        |
|                                                                                    | Shoulder, arm, or forearm | 12            | 23       |
|                                                                                    | Hand                      | 50            | 63       |
|                                                                                    | Thigh or leg              | 16            | 9        |
|                                                                                    | Feet                      | 4             | 3        |

Talan. N Engl J Med.1999; 340:8

# Dog bites- presentation

- Within 8 hours after bite
  - Crush injury
  - Disfiguring injury
  - Concerned for tetanus o
- Later than 8 hours after
  - Usually infected



# Dog bites- infections

- Principal causes- dog's oral flora
  - Polymicrobial
- Aerobes
  - *Pasteurella* spp
  - *Streptococci* spp
  - *Staphylococci* spp
- Anaerobes
  - *Fusobacterium* spp
  - *Bacteroides* spp

# Dog bites- microbiology

*Acinetobacter* spp.

*Actinobacillus*

*actinomycetemcomitans*

*Bacteroides tectus*

*Burgeyella* (*Weeksella*) *zooheicum*

*Capnocytophaga canimorsus*

*Capnocytophaga cynodegmi*

*Corynebacterium minutissimum*

*Eikenella corrodens*

*Enterococcus* spp.

*Fusobacterium nucleatum*

*Fusobacterium russii*

*Haemophilus aphrophilus*

*Leifsonia* (*Corynebacterium*)

*aquaticum*

*Leptotrichia buccalis*

*Micrococcus luteus*

*Moraxella* spp.

*Neisseria canis*

*Neisseria weaveri*

*Pasteurella multocida* subsp.

*multocida*

*Pasteurella multocida* subsp. *septica*

*Pasteurella dagmatis*

*Pasteurella canis*

*Pasteurella stomatis*

*Peptostreptococci*

*Porphyromonas asaccharolytica*

*Porphyromonas gulae* (*gingivalis*)

*Porphyromonas canoris*

*Prevotella bivia*

*Prevotella heparinolytica*

*Prevotella melaninogenica*

*Prevotella intermedia*

*Prevotella zoogloformans*

*Staphylococcus aureus*

*Staphylococcus intermedius*

*Staphylococcus epidermidis*

*Streptococci*,  $\alpha$ -hemolytic,

$\beta$ -hemolytic

*Veillonella parvula*

**TABLE 2. TYPES OF MICROORGANISMS ISOLATED FROM 50 DOG BITES AND 57 CAT BITES, ACCORDING TO THE TYPE OF INFECTION.\***

| TYPE OF<br>MICROORGANISMS | ABSCESS                   |                       | PURULENT<br>WOUND     |                       | NONPURULENT<br>WOUND  |                       |
|---------------------------|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                           | DOG<br>BITE<br>(N=6)      | CAT<br>BITE<br>(N=11) | DOG<br>BITE<br>(N=29) | CAT<br>BITE<br>(N=22) | DOG<br>BITE<br>(N=15) | CAT<br>BITE<br>(N=24) |
|                           | number of bites (percent) |                       |                       |                       |                       |                       |
| Aerobes only              | 1 (17)                    | 3 (27)                | 10 (34)               | 7 (32)                | 10 (67)               | 8 (33)                |
| Anaerobes only            | 1 (17)                    | 0                     | 0                     | 0                     | 0                     | 0                     |
| Aerobes and anaerobes     | 4 (67)                    | 8 (73)                | 18 (62)               | 14 (64)               | 2 (13)                | 14 (58)               |
| No growth on culture      | 0                         | 0                     | 1 (3)                 | 1 (5)                 | 3 (20)                | 2 (8)                 |

| Agent                       | Percentages of Isolates Susceptible |                     |                      |                       |                           |                            |
|-----------------------------|-------------------------------------|---------------------|----------------------|-----------------------|---------------------------|----------------------------|
|                             | Staphylococcus aureus               | Eikenella corrodens | Anaerobes            | Pasteurella multocida | Capnocytophaga canimorsus | Staphylococcus intermedius |
| Penicillin                  | 10                                  | 99                  | 50/95 † <sub>P</sub> | 95                    | 95                        | 70                         |
| Dicloxacillin               | 99                                  | 5                   | 50                   | 30                    | NS                        | 100                        |
| Amoxicillin/clavulanic acid | 100                                 | 100                 | 100                  | 100                   | 95                        | 100                        |
| Cephalexin                  | 100                                 | 20                  | 40                   | 30                    | NS                        | 95                         |
| Cefuroxime                  | 100                                 | 70                  | 40                   | 90                    | NS                        | NS                         |
| Cefoxitin                   | 100                                 | 95                  | 100                  | 95                    | 95                        | NS                         |
| Erythromycin                | 100                                 | 20                  | 40                   | 20                    | 95                        | 95                         |
| Tetracycline                | 95                                  | 85                  | 60                   | 90                    | 95                        | NS                         |
| TMP-SMX                     | 100                                 | 95                  | 0                    | 95                    | V                         | NS                         |
| Ciprofloxacin               | 100                                 | 100                 | 40                   | 95                    | 100                       | 100                        |
| Levofloxacin                | 100                                 | 100                 | 60                   | 100                   | 100                       | 100                        |
| Trovafoxacin                | 100                                 | 100                 | 85 †                 | 100                   | 100                       | 100                        |
| Moxifloxacin                | 100                                 | 100                 | 85 †                 | 100                   | 100                       | 100                        |
| Azithromycin                | 100                                 | 80                  | 70 † <sub>S</sub>    | 100                   | 100                       | NS                         |
| Clarithromycin              | 100                                 | 60                  | 70 † <sub>S</sub>    | 70                    | 100                       | NS                         |
| Ketolides (HMR 3647)        | 100                                 | 100                 | 85 †                 | 100                   | NS                        | 100                        |
| Clindamycin                 | 95                                  | 0                   | 100                  | 0                     | 95                        | 95                         |

# Dog bites- infections

- Typical presentation
  - Cellulitis-wound
- Complications
  - Septic arthritis
  - Tenosynovitis
  - Abscess
  - Osteomyelitis
- Higher risk
  - Chronic extremity edema
  - Immunocompromised



# Uninfected dog bites- management

- Normal saline irrigation
- Debride devitalized tissue
- Evaluate for possible
  - Foreign body
  - Bone/joint
  - Nerve
  - Vascular involvement
- Do not culture
- Primary closure of facial wounds-others unclear
- Close follow-up

# Uninfected dog bites- management

- Prophylaxis (3-5 days)- for most wounds
  - Amoxicillin-clavulanate
  - TMP-SMX + clindamycin
  - FQN + clindamycin
- Evaluate for tetanus and rabies prophylaxis

# Infected dog bites- management

- Hand wound infections or joint/bone involvement
  - Surgical consultation
- Outpatient therapy (10-14 days)
  - Amoxicillin-clavulanate
  - TMP-SMX + clindamycin
  - FQN + clindamycin
- Inpatient therapy
  - Ampicillin-sulbactam
  - FQN + clindamycin

# Dog bites- special situation

- An asplenic patient develops septic shock after suffering a minor bite from her dog.
- What is the pathogen?

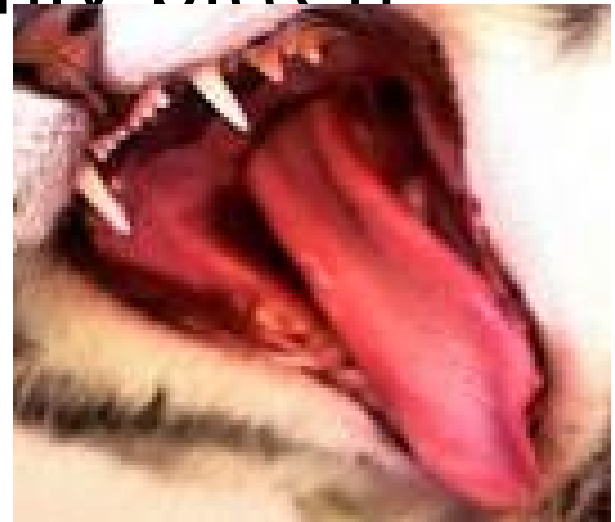
*Capnocytophaga*  
*canimorsis*

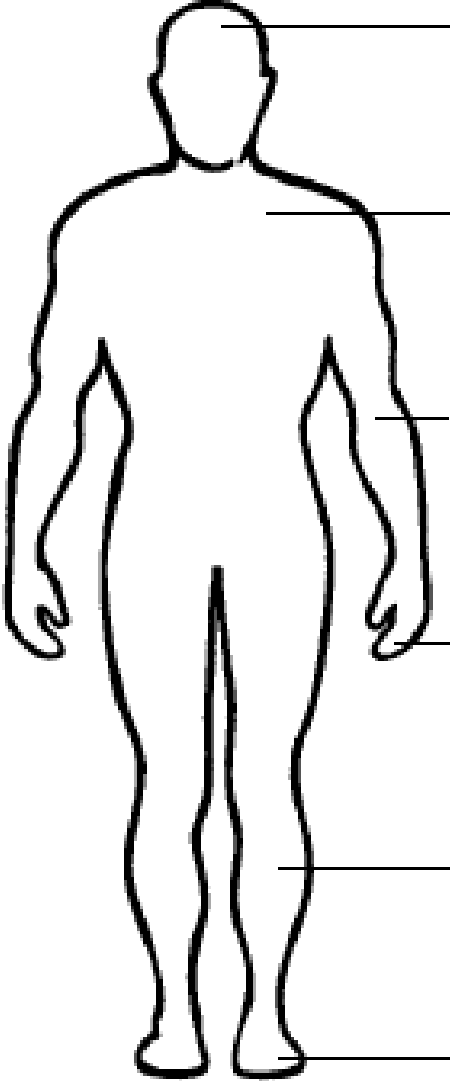
# Cat bites



# Cat bites

- Higher risk of infection
  - Up to 80% become infected
  - Deeper puncture wounds
  - More joint and bone involvement
- Women are most commonly bitten



|                                                                                    | Location<br>of Wound         | Dog<br>Bite   | Cat<br>Bite |
|------------------------------------------------------------------------------------|------------------------------|---------------|-------------|
|                                                                                    |                              | % of patients |             |
|  | Face, scalp,<br>or neck      | 16            | 2           |
|                                                                                    | Trunk                        | 2             | 0           |
|                                                                                    | Shoulder, arm,<br>or forearm | 12            | 23          |
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# Cat bites- infections

- Principal causes- cat's oral flora
  - Polymicrobial
- Aerobes
  - ***Pasteurella* spp- 75% of bites**
  - *Streptococci* spp
  - *Staphylococci* spp
- Anaerobes
  - *Fusobacterium* spp
  - *Bacteroides* spp

# Cat bites- microbiology

*Acinetobacter* spp.

*Actinobacillus*

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| Cefoxitin                   | 100                                 | 95                         | 100                  | 95                           | 95                               | NS                                |
| Erythromycin                | 100                                 | 20                         | 40                   | 20                           | 95                               | 95                                |
| Tetracycline                | 95                                  | 85                         | 60                   | 90                           | 95                               | NS                                |
| TMP-SMX                     | 100                                 | 95                         | 0                    | 95                           | V                                | NS                                |
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# Cat bites- infections

- Typical presentation
  - Cellulitis surrounding wound
- Complications
  - **Septic arthritis**
  - **Tenosynovitis**
  - Abscess
  - Osteomyelitis
- Higher risk
  - Chronic extremity edema
  - Immunocompromised





# Cat bites- management

- Prophylaxis (3-5 days) for everyone
  - Amoxicillin-clavulanate
  - TMP-SMX + Clindamycin
  - FQN + Clindamycin
- Evaluate for tetanus and rabies prophylaxis
- Hand wound infections or joint/bone involvement
  - Surgical consultation
- Outpatient therapy (10-14 days)
- Inpatient therapy
  - Ampicillin-sulbactam
  - FQN + clindamycin

# Simian bites

- Pets, lab animals, or in wild
- Bacterial infections
  - Broad spectrum of isolates
  - Similar to human bite wounds
    - $\alpha$ -hemolytic streptococci
    - *S. epidermidis*
    - Enterococci and Enterobacter
    - *Bacteroides* spp. and *Fusobacterium* spp.
    - *Eikenella corrodens*





# Simian bites

- Herpes B virus in macaques
  - Ascending encephalomyelitis in humans
    - Over 70% mortality
  - Guidelines available for exposure management



# Rat bites

- Rat bite characteristics
  - 72% of bites occurred while victim was sleeping
  - 84% on face or upper extremities
  - Only 1 in 50 developed an infection
- Rat bite fever
  - Systemic illness
  - *Streptobacillus moniliformis*
  - *Spirillum minus*
- Prophylaxis
  - Amox-clav or doxycycline



# Rabies



# Rabies- epidemiology

- In the US
  - 1-5 cases annually
  - Up to 40,000 receive prophylaxis
- In the underdeveloped world
  - 55,000 estimated annually
- Rabies free
  - Antarctica
  - Hawaii
  - Many Pacific and Caribbean islands

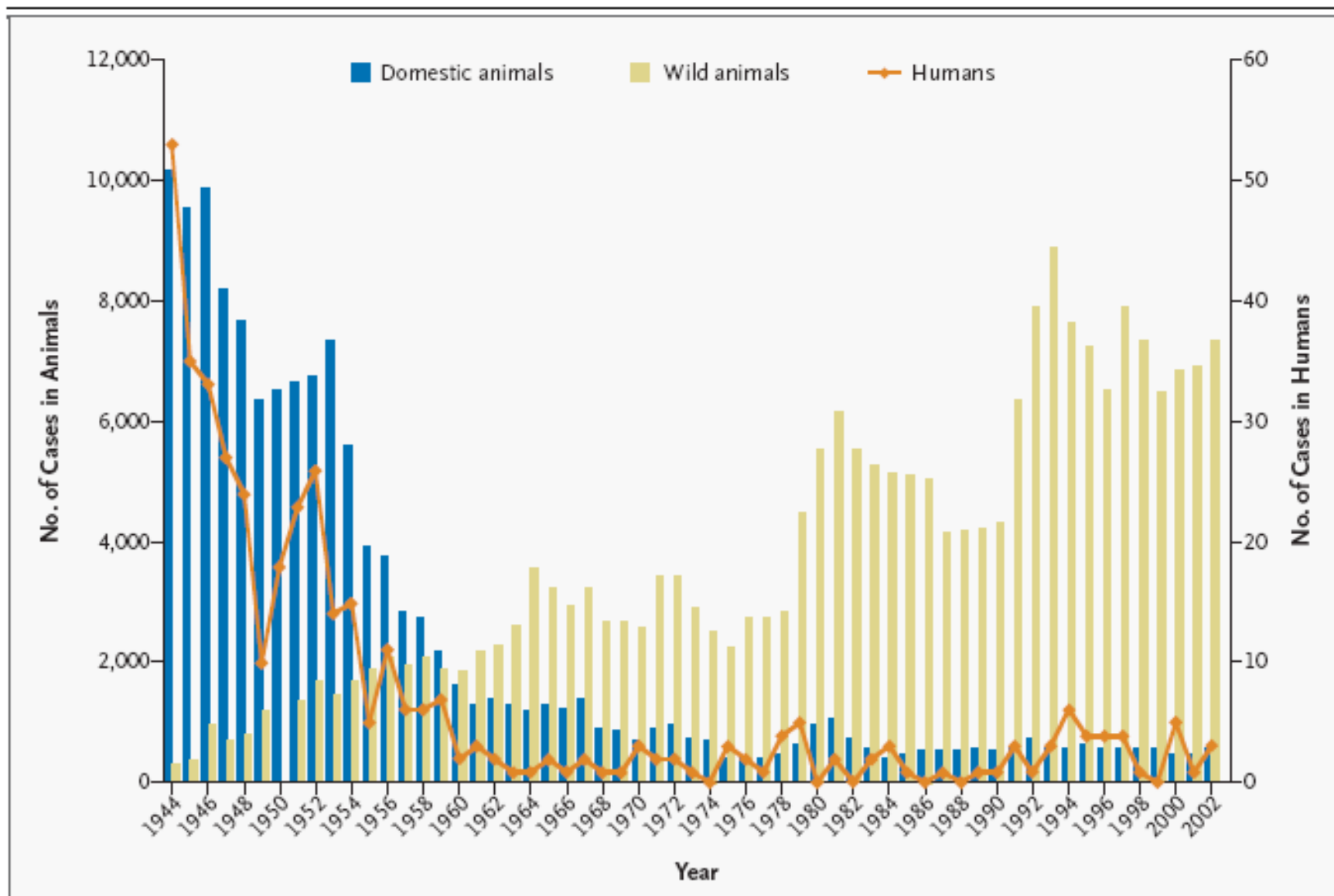


**Figure 1.** Temporal Trends in the Diagnosis of Rabies in the United States, 1944 to 2002.

# Rabies- epidemiology

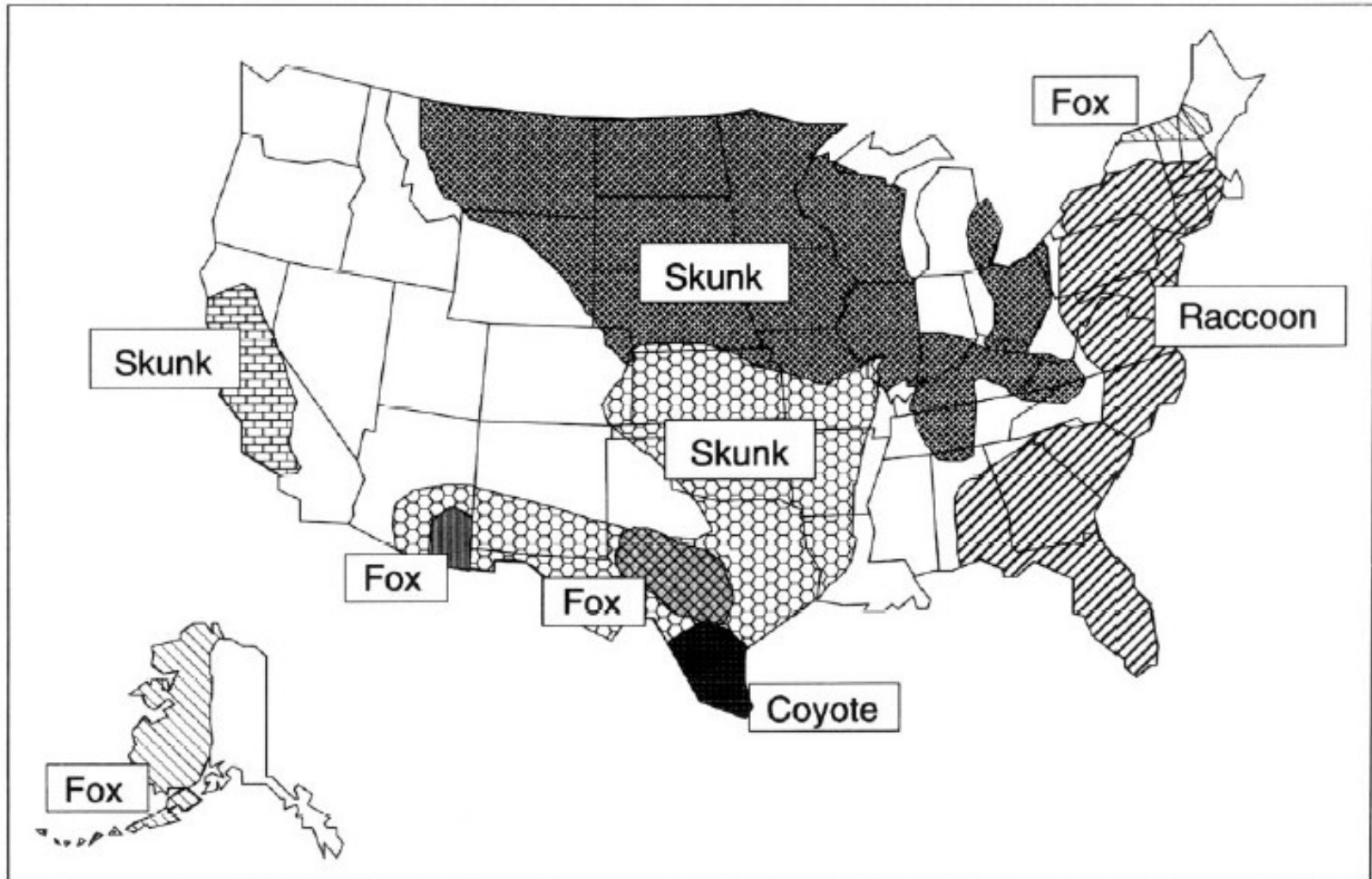
- All mammals are susceptible
- Vectors- transmit
  - 2/3 of cases caused by bats in US
  - Dogs- the rest of the world (India, SEA, Africa)
  - Bats- 4% in the rest of the world
- Reservoirs- maintain disease
  - Carnivorous mammals
  - Bats

# Rabies- epidemiology

**Table 2.** Principal animal vectors of rabies.

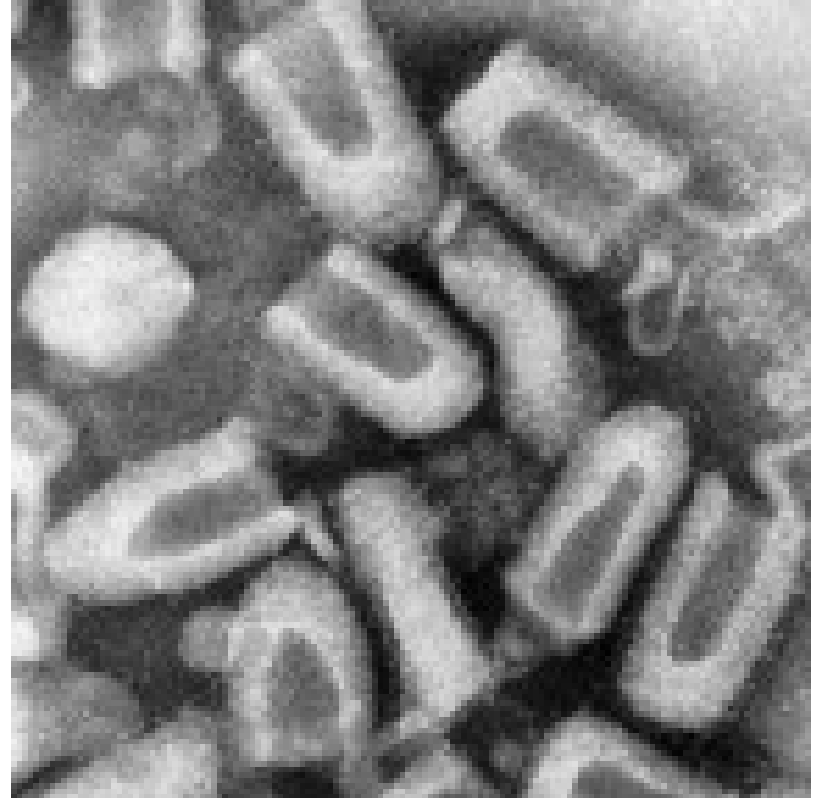
| Location       | Vectors                                      |
|----------------|----------------------------------------------|
| North America  | Skunks, raccoons, foxes, bats                |
| Western Europe | Foxes, bats                                  |
| Eastern Europe | Foxes, dogs                                  |
| Latin America  | Dogs, bats                                   |
| Caribbean      | Mongoose                                     |
| Africa         | Dogs, jackals, mongooses, foxes              |
| Asia           | Dogs, cats, monkeys, mongooses, arctic foxes |

# Rabies- reservoirs



# Virology

- Rabies
  - Family Lyssavirus
  - Genus Rhabdovirus
- 7 serotypes
- Bullet shaped
  - single stranded RNA virus



# Transmission

- Saliva from infected animal introduces virus
  - Bite
  - Scratch
  - Mucous membranes
- Human-human transmission-theoretical
- Organ transplants from unknown CNS deaths
  - Corneal transplants
- Airborne from spelunking

# Pathogenesis

- Incompletely understood
- Slowly replicates in muscle cells at wound site
- Enters nerve that innervates muscle spindle
- Virus travels passively up the axon to nucleus
  - 1-40 cm/day
- Passes from neuron to neuron
- Viruses travels axonally to skin and salivary glands
  - Released in saliva

# Pathogenesis

- Furious rabies
  - Encephalitis with Negri bodies
  - Minimal neuronal death
  - Interference with neurotransmission\*
- Paralytic rabies- affects the spinal cord
  - Severe inflammation and necrosis
  - Peripheral nerve demyelination (similar to GBS)
- Systemic disease
  - Myocarditis with Negri bodies

# Negri bodies



# Clinical manifestations

- Risk of disease higher with
  - Bite on the face
  - Multiple bites (larger viral inoculum)
- Incubation period 20-60 days
- Fulminant disease in 5-6 days
- 1-3% of cases longer than 6 months
- Rabies has occurred 19 yrs after exposure

# Clinical manifestations

- Initial symptoms
  - Fever
  - Headache
  - Malaise
  - Tingling or severe pruritis at wound site
  - Subtle personality changes or anxiety
- After 2-10 days neurologic symptoms/signs begin
  - Encephalitic rabies
  - Paralytic (apathetic) rabies

# Furious/Encephalitic rabies

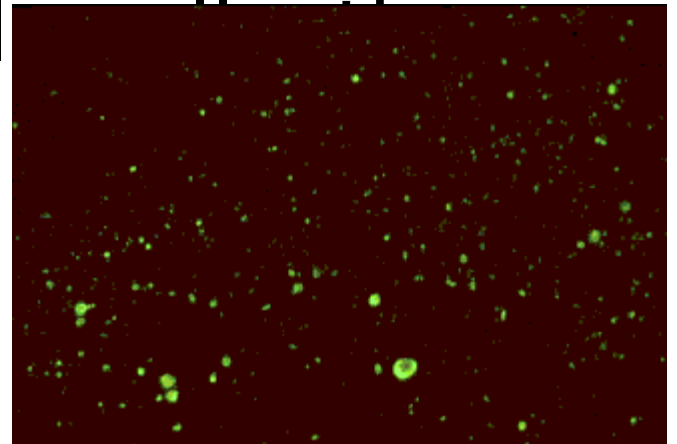
- Symptoms/signs
  - Agitation-confusion
  - Hydrophobia
  - Aerophobia
  - Hypersalivation
  - Hyperventilation
  - Priapism
  - Seizures
  - Arrhythmias
- Coma within 2 to 14 days
- Death by 18<sup>th</sup> day after symptoms

# Paralytic/Dumb rabies

- Symptoms/signs
  - Ascending paralysis
    - Resembles Guillain-Barre syndrome
  - Weakness
  - Headache and nuchal rigidity
  - No hydrophobia, hyperactivity, or seizures
- Coma within 2 to 14 days
- Death by 18<sup>th</sup> day after symptoms
  - Respiratory failure
  - Myocarditis\*

# Diagnosis

- Animal diagnosis
  - Direct fluorescent antibody staining (DFA) of brain tissue
- Human diagnosis- premortem
  - DFA of nape of the neck biopsy (hair follicles)
  - PCR of saliva or CSF
- Instructions for sampling and submission
  - CDC website



# Cell-culture vaccines available

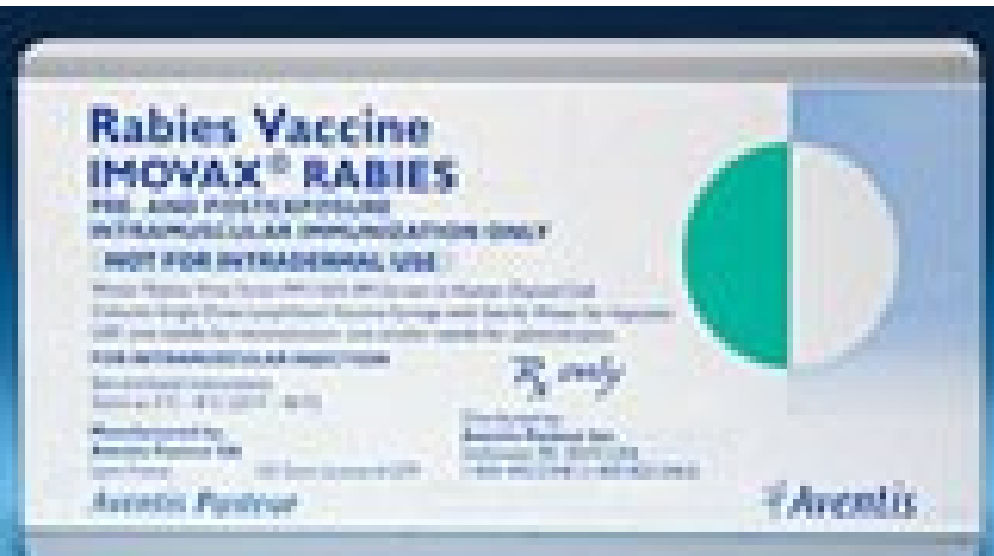
| Product                            | Dose     | Route         | Indications                  |
|------------------------------------|----------|---------------|------------------------------|
| Vaccines†                          |          |               |                              |
| RabAvert (Chiron Behring)‡         | 1 ml     | Intramuscular | Preexposure or postexposure§ |
| Rabies vaccine adsorbed (BioPort)¶ | 1 ml     | Intramuscular | Preexposure or postexposure§ |
| Imovax Rabies (Aventis Pasteur)‡   | 1 ml     | Intramuscular | Preexposure or postexposure§ |
| Human rabies immune globulins**    |          |               |                              |
| BayRab (Bayer)                     | 20 IU/kg | Local††       | Postexposure only            |
| Imogam Rabies-HT (Aventis Pasteur) | 20 IU/kg | Local††       | Postexposure only            |

# Vaccine- who gets it?

- Veterinarians
  - Booster every 2-3 years
- Dog catchers
- Lab workers- if rabies exposure is possible
- Mail carriers
- Travelers
  - Where medical care access is limited
  - Joggers
- Peace corps workers

# Vaccine- schedule

- Pre-exposure prophylaxis
  - 0, 7, 21 or 28 days
- Intramuscular or intradermal



# Vaccine- caveats

- Intradermal vaccination for pre-exposure prophylaxis
  - Lower dose
  - Lower cost
  - Needs skill in administration
- Not for people taking chloroquine
  - Antibody response is lowered by chloroquine

# Post-exposure prophylaxis

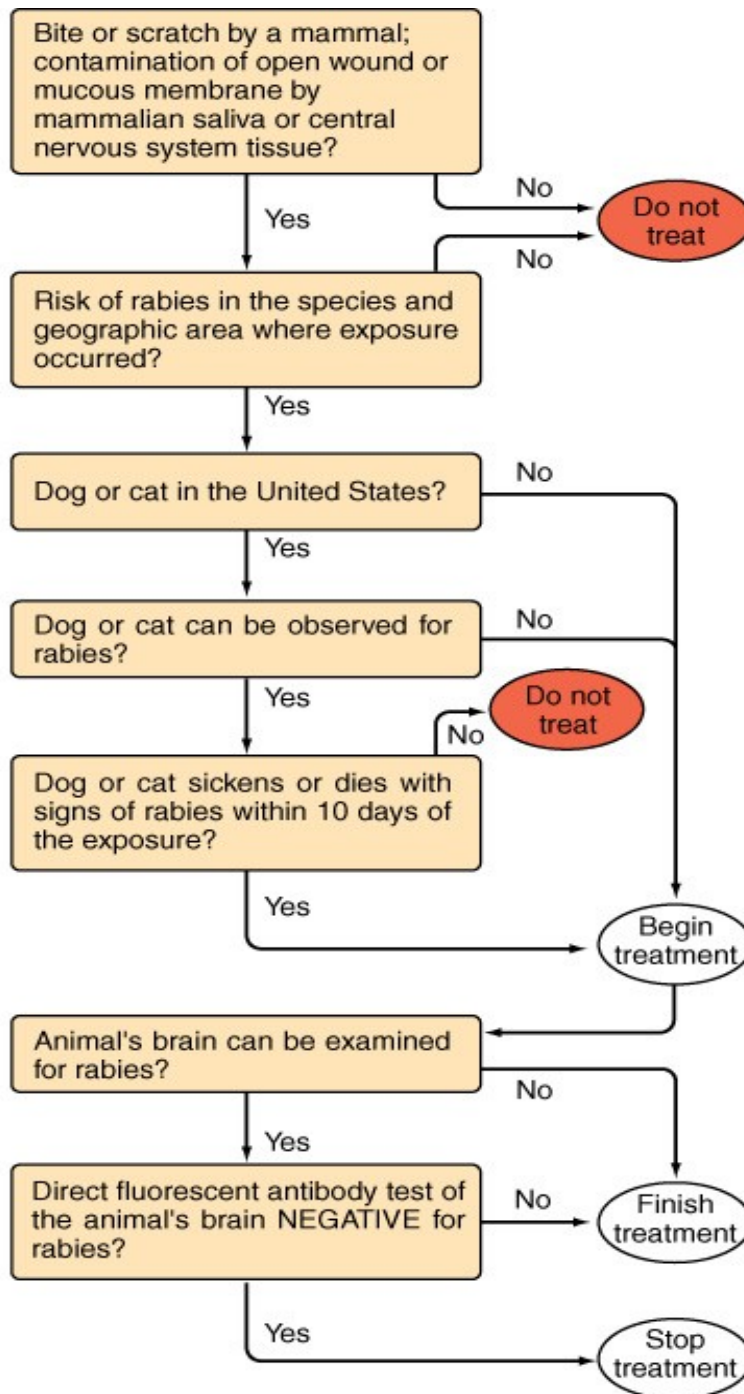
- The recipe- all three are important
  - Reduces risk by at least 90%
- ***Wound cleansing*** (slowly replicating virus)
  - Soap and water
  - 70% alcohol
  - 1% povidone iodine
- Passive antibody (HRIG)
- Active immunization

# Post-exposure prophylaxis

- Previously vaccinated
  - **NO HRIG**
  - IM deltoid vaccine on day 0 and 3
- Unvaccinated patient
  - 20 IU/Kg HRIG at wound site/gluteal region
  - IM deltoid vaccine on day 0, 3, 7, 14, 28
- Do not give HRIG and vaccine in the same site

# Post-exposure prophylaxis

- Regard as rabid
  - Raccoons
  - Bats
  - Foxes
- May need prophylaxis
  - Dogs
  - Cats
  - Ferrets
- No prophylaxis
  - Squirrels
  - Chipmunks
  - Hamsters
  - Rabbits
  - Rats
  - Gerbils
  - Mice



# The Quiz

- 35 yo man bitten by dog in Bangkok
- 82 yo woman bitten by squirrel in Silver Spring, Md
- 33 yo ID fellow bitten on the nose by his cat
- 15 yo paper boy bitten by stray dog in San Antonio
- 40 yo woman who is “bumped” by a bat she’s chasing with a tennis racket in her house
- 33 yo ID fellow bitten on the nose by his cat
- 22 yo soldier hit in the face with a bat while riding in a truck in Iraq